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Premedication for intrathecal anesthesia in dogs: xylazine versus propofol

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ABSTRACT

This study aimed to compare the effects of xylazine or propofol before intrathecal (IT) bupivacaine administration in dogs. The study was conducted in two groups of 10 dogs each. In group I (XG), intrathecal injection of 20 mg bupivacaine was administered into the subarachnoid space in the lumbosacral area after treatment with 1 mg/kg intravenous (iv) xylazine. In group II (PG), 4 mg/kg iv propofol was administered before IT bupivacaine administration. The onset, duration, and magnitude of sensory block (scale 0–3) were determined using the pin-prick test throughout the anesthesia. Duration of surgery (XG: 47.20 ± 5.01 min, PG: 50.85 ± 6.97 min) and duration of anesthesia (XG: 92.20 ± 7.02 min, PG: 94.50 ± 7.26 min) were not significantly different between the groups. This study concludes that propofol administration before IT anesthesia with bupivacaine maintains safe levels of IT anesthesia and can therefore be used as an alternative to xylazine treatment.

Keywords

Xylazine, Propofol, Intrathecal anesthesia, Bupivacaine, Dog

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Abbreviations

XG: Xylazine group
PG: Propofol group
SBP: Systolic blood pressure
DBP: Diastolic blood pressure
MBP: Mean arterial pressure
HR: Heart rate
RR: Respiratory rate
RT: Rectal temperature
AST: Aspartate aminotransferase
ALT: Alanine aminotransferase
BUN: Blood urea nitrogen

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Introduction

Spinal or intrathecal (IT) anesthesia is performed by injecting local anesthetics into the subarachnoid space. This technique provides ideal anesthesia and muscle relaxation for pelvic and hind limb surgery. Administration of local anesthetics into the subarachnoid space and cerebrospinal fluid leads to sympathetic, sensory, and motor nerve block [1-3].

Bupivacaine is an amide-type long-acting local anesthetic. IT bupivacaine is safer than many other local anesthetics, such as lidocaine and levobupivacaine, which cause ventricular arrhythmia and cardiotoxicity. Therefore, the use of IT bupivacaine remains popular [2,4,5].

Spinal or IT anesthesia, known for its superiority over general anesthesia, is preferred for orthopedic surgery of the hind limbs [6-9]. However, IT anesthesia is associated with complications such as permanent nerve damage. These complications can be caused by local anesthetic-mediated neurotoxicity or pre-anesthetic intervention or injection manipulations within the theca or subarachnoid area [1]. Therefore, pre-medication is an equally important consideration as the choice of local anesthetic [2].

Humans should be conscious during IT anesthesia. However, such concerns are unwarranted during injections or IT anesthesia in animals. Therefore, in animals, IT anesthesia is often performed following sedation with xylazine. This study aimed to compare the effects of xylazine and propofol before IT bupivacaine administration in dogs.

Results

The study results were evaluated in terms of clinical, hemodynamic, and biochemical parameters. There was no statistically significant difference between the groups in terms of body weight (XG: 22.50 ± 4.93 kg, PG: 24.50 ± 4.77 kg), age (XG: 3.40 ± 1.57 years, PG: 3.70 ± 1.88 years), duration of surgery (XG: 47.20 ± 5.01 min, PG: 50.80 ± 6.97 min) and duration of IT anesthesia (XG: 92.20 ± 7.02 min, PG: 94.50 ± 7.26 min) as shown in Table 1. The IT injections were easy to perform and well tolerated by all dogs under sedation with xylazine (xylazine + desensitization of lumbosacral region and ligamentum flavum) or propofol (propofol alone). None of the dogs in either group experienced difficulty in the effort for reach to the sternal position or other abnormal conditions during the entire duration of IT anesthesia.

SBP, DBP, MBP, HR, RR, and RT were not significantly different at baseline and following recovery from anesthesia ($p > 0.05$), although statistically significant differences in baseline values were observed between IT anesthesia with xylazine versus propofol application ($p < 0.05$). DBP and HR were statistically significant at 60 min ($p < 0.05$). MBP was statistically significant at 15, 30, and 60 min post-IT injection ($p < 0.05$). RR and RT were not significantly different between XG and PG ($p > 0.05$). These values and differences are summarised in Table 2.

Serum glucose, ALT, AST, and BUN values were not significantly different between the groups. Although statistically significant differences were observed within groups for these parameters, they were all within the reference range of values (Table 3).

Discussion

This study aimed to compare the use of xylazine and propofol as pre-medication during IT anesthesia in dogs undergoing orthopedic surgery. We used bupivacaine in our study because of its proven reliability and wide use as an IT anesthetic [1,9,10]. Similarly, xylazine is widely used for pre-medication and its effects are well-known [11,12]. Therefore, it was used in the control group in this study. However, the use of propofol has not been evaluated in this context before.

Despite its weak analgesic effect, propofol is often administered with many different combinations before anesthesia to immobilize the patient, maintain safe and comfortable anesthesia and aid easy recovery

Table 1.
Distribution of body weight, age, duration of surgery, and IT anaesthesia in different groups.

Groups	Body weight (kg)	Age (year)	Duration of surgery (min)	Duration of IT anaesthesia (min)
XG (n=10)	22.50 ± 4.93	3.40 ± 1.57	47.20 ± 5.01	92.20 ± 7.02
PG (n=10)	24.50 ± 4.77	3.70 ± 1.88	50.80 ± 6.97	94.50 ± 7.26
p	0.418	0.691	0.079	0.342

Table 2.
Mean ± SD of heart rate (HR), systolic arterial blood pressure (SBP), diastolic arterial blood pressure (DBP), mean arterial blood pressure (MBP), respiratory rate (RR), and rectal temperature (RT) in different groups.

Values	Groups	Time (min) 0	Premedication	5	15	30	60	90	120	*p*
SBP	XG	138.20 ± 7.48^{a}	124.60 ± 7.68^{bc}	117.10 ± 7.56^{bc}	112.60 ± 9.51^{c}	124.00 ± 6.51^{bc}	139.70 ± 7.06^{a}	131.60 ± 9.78^{ab}	126.60 ± 9.43^{b}	0.000
	PG	135.90 ± 7.58^{a}	118.00 ± 9.92^{bcl}	110.70 ± 7.97^{bc}	109.60 ± 7.17^{c}	121.80 ± 3.55^{d}	136.00 ± 4.32^{a}	131.20 ± 3.88^{a}	128.30 ± 4.22^{ad}	0.000
	p	0.198	0.082	0.124	0.440	0.406	0.113	0.446	0.644	
DBP	XG	96.70 ± 6.13^{a}	92.10 ± 5.86^{ab}	87.80 ± 5.20^{b}	96.60 ± 4.33^{b}	88.80 ± 4.34^{b}	96.10 ± 5.13^{a}	94.20 ± 5.20^{ab}	92.10 ± 3.84^{ab}	0.000
	PG	95.40 ± 4.81^{a}	91.20 ± 4.83^{ab}	86.40 ± 3.50^{bc}	84.10 ± 3.67^{c}	84.30 ± 4.19^{c}	94.40 ± 5.48^{a}	91.10 ± 5.17^{ab}	87.30 ± 3.12 b^{c}	0.000
	p	0.509	0.618	0.322	0.057	0.013	0.234	0.133	0.001	
MBP	XG	111.70 ± 4.42^{a}	106.80 ± 3.99^{ab}	101.80 ± 3.49^{b}	101.10 ± 3.45^{b}	105.00 ± 4.67^{b}	111.60 ± 3.50^{a}	110.00 ± 5.31^{a}	107.80 ± 5.01^{ab}	0.000
	PG	111.20 ± 2.70^{a}	106.10 ± 3.45^{b}	99.20±2.70^{c}	94.90 ± 2.68^{c}	94.20 ± 3.19^{c}	110.60 ± 3.13^{a}	108.60 ± 5.25^{ab}	100.20 ± 5.12^{c}	0.000
	p	0.551	0.466	0.012	0.000	0.000	0.138	0.196	0.007	
HR	XG	85.50 ± 1.84 ^{a}	81.60 ± 1.57^{b}	78.40 ± 1.26^{c}	78.20 ± 1.47^{c}	76.70 ± 2.40^{c}	83.90 ± 2.60^{b}	82.60 ± 2.11^{b}	78.10 ± 2.02^{c}	0.000
	PG	85.60 ± 2.22 ^{a}	81.40 ± 1.89^{b}	77.80 ± 1.75^{c}	77.90 ± 0.99^{c}	78.90 ± 2.02^{c}	84.20 ± 1.98^{ab}	82.80 ± 1.68^{b}	81.50 ± 1.26^{br}	0.000
	p	0.931	0.823	0.468	0.541	0.082	0.769	0.853	0.003	
RR	XG	26.80 ± 3.01^{a}	18.30 ± 1.88^{bc}	17.10 ± 2.07^{b}	17.10 ± 2.02^{b}	19.30 ± 1.88^{b}	26.00 ± 3.27^{a}	25.40 ± 2.71^{a}	21.40 ± 1.71^{c}	0.000
	PG	27.80 ± 2.89^{a}	16.70 ± 3.53^{b}	17.40 ± 2.63^{b}	17.60 ± 2.50^{b}	19.70 ± 2.11^{b}	27.20 ± 2.57^{a}	25.90 ± 2.80^{ac}	23.20 ± 2.34^{c}	0.000
	p	0.596	0.269	0.799	0.563	0.637	0.484	0.747	0.091	
RT	XG	38.59 ± 0.11^{a}	38.45 ± 0.15^{ab}	38.10 ± 0.10^{c}	37.96 ± 0.12^{c}	37.98 ± 0.04^{c}	38.42 ± 0.19^{abc}	38.19 ± 0.53^{bc}	38.21 ± 0.53^{bc}	0.000
	PG	38.60 ± 0.13^{a}	38.30 ± 0.23^{b}	38.09 ± 0.17^{bc}	37.96 ± 0.11^{c}	37.96 ± 0.08^{c}	38.56 ± 0.06^{a}	38.38 ± 0.21^{ab}	38.16 ± 0.15^{bc}	0.000
	p	0.832	0.110	0.872	1.000	0.555	0.106	0.290	0.766	

a-c: different letters (a-b) on the same line ($p < 0.05$) in group, *Significantly different between groups ($p < 0.05$)

Table 3.
Distrubition of serum glucose, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and blood urea nitrogen (BUN) values between groups

Values	Groups	Time (min)					*p*
		0	5	15	60	**120**	
Glucose mg/dl	XG	71.64 ± 5.10^{a}	77.04 ± 4.88^{ab}	78.28 ± 3.73^{b}	80.08 ± 4.33b^{c}	84.80 ± 4.01^{c}	0.000
	PG	70.20 ± 4.62^{a}	76.55 ± 5.74^{ab}	77.08 ± 6.39^{ab}	81.01 ± 8.43^{b}	81.94 ± 12.11^{b}	0.016
p		0.420	0.861	0.657	0.827	0.374	
AST U/I	XG	49.61 ± 4.01^{a}	42.94 ± 2.78^{b}	40.42 ± 2.55^{bc}	36.26 ± 3.33^{c}	36.53 ± 3.19^{c}	0.000
	PG	48.45 ± 2.37^{a}	43.19 ± 2.23^{b}	37.82 ± 2.92^{c}	35.31 ± 3.84^{c}	38.24 ± 4.36^{c}	0.000
p		0.899	0.859	0.058	0.336	0.316	
ALT U/I	XG	65.81 ± 8.79^{a}	44.16 ± 4.36^{b}	39.45 ± 6.28^{bc}	31.49 ± 6.27^{cd}	26.54 ± 3.13^{d}	0.000
	PG	54.47 ± 8.39^{a}	43.81 ± 4.34^{b}	38.14 ± 5.11^{b}	29.45 ± 3.97^{c}	27.73 ± 2.93^{c}	0.000
p		0.791	0.870	0.602	0.257	0.458	
BUN mg/dL	XG	7.18 ± 1.86^{a}	9.48 ± 3.36^{ab}	10.44 ± 2.61^{ab}	15.35 ± 5.59^{bc}	17.61 ± 6.74^{c}	0.000
	PG	7.29 ± 2.30^{a}	8.60 ± 1.57^{a}	11.10 ± 3.46^{ab}	15.37 ± 5.71^{b}	17.28 ± 6.11^{b}	0.000
p		0.928	0.518	0.556	0.993	0.835	

a-c: different letters (a-b) in a row denote significant differences ($p < 0.05$)

from anesthesia with minimal side effects [9,13]. The dogs in the PG group in our study were prepared for anesthesia using propofol before IT anesthesia. Effective induction was achieved in a short time in all cases in this group. The subarachnoid injection was easily performed and induction enabled manipulations. In the XG group, ligamentum flavum desensitization was required for performing spinal injections. Manipulations during subarachnoid injections and local anesthesia of the ligamentum flavum may be areas of concern despite the animal being sedated. Therefore, we believe that propofol provides the advantage of the comfortable application of subarachnoid manipulations.

The use of xylazine or propofol as pre-medication did not affect the duration or depth of anesthesia. The duration and depth of anesthesia were statistically similar in both groups (Table 1).

Slowing of venous circulation during intrathecal anesthesia is known to induce hypotension [9]. Accordingly, HR, SBP, DBP, and MBP values in our study were depressed during IT anesthesia but were not significantly different at baseline or following recovery from anesthesia. However, DBP and HR were significantly different at 60 min and MBP was significantly different at 15, 30, and 60 min after administration of IT anesthesia (Table 2). These decreases were found to be statistically significant between the groups and were clinically acceptable. Depression in both the circulatory and respiratory systems was higher in the PG group. This may be considered a disadvantage compared with xylazine use. Apnoea and/or dose-dependent respiratory depression with propofol use was previously reported (9,13). Therefore, it is recommended that propofol should be administered at the lowest possible dose and i.v. injections should not be performed very quickly.

There were no significant differences between the groups in terms of biochemical parameters, but significant changes were observed within the groups during IT anesthesia (Table 3). However, glucose, ALT, AST, and BUN values were following the reference values [14].

Cranial migration of the local anesthetic into the cerebrospinal fluid within the medullar canal is undesirable. Several factors, such as the anatomical structure of the animal, density of the local anesthetic used and speed of injection affect cranial migration [1,15]. To avoid this migration, the head of the animal should be kept elevated above the rest of the body by tilting the operating table. This restricts the local anesthetic to a limited region due to the effect of gravity [9]. In our study, no anesthesia-associated complications were observed.

Despite its respiratory depressant effect, propofol is widely used for induction in gas anesthesia owing to advantages such as comfortable and safe recovery from anesthesia, minimum side effects and short-term general anesthesia. However, the analgesic effect of propofol is weak [9,13].

In this study, no comparison was made between the groups in terms of postoperative analgesia because IT anesthesia provided postoperative analgesia and good muscle relaxation. Furthermore, it has been previously reported that a 20% increase in HR, SBP, and RR values during surgery may be indicative of intraoperative pain [9,10,16]. In our study, pulse and respiration values were depressed during anesthesia but were the same as baseline values after recovery from anesthesia. Additionally, there was no evidence of intraoperative pain or any other complication.

In dogs, the use of xylazine for pre-medication has advantages such as good sedation and muscle relaxation. However, the animal may be unduly stressed or complications may occur during the manipulation of spinal injections. Additionally, desensitization of ligamentum flavum is required during xylazine injection. Propofol is primarily used for the induction of gas anesthesia or in combination with other anesthetics. Our study found propofol to be more beneficial than xylazine for pre-medication in spinal anesthesia, particularly during intrathecal injections. Nonetheless, propofol-mediated respiratory depression should also be considered.

Materials & Methods

The study was conducted on 20 dogs following approval by the Animal Research Local Ethics Committee of Kafkas University (KAU-HADYEK, 2015/040). Twenty client-owned dogs scheduled for orthopedic surgery were enrolled in a blunt randomized, prospective, clinical study after obtaining written consent from the owners.

The animals were categorized into two groups: one group receiving xylazine (XG, n = 10) and the other receiving propofol (PG, n = 10). In the XG group, the dogs were sedated with xylazine (2% Rompun®, Bayer, Turkey, 1 mg/kg i.v.). Dogs were placed in the prone position and the lumbosacral region was shaved and disinfected. Next, local infiltration anesthesia (Adokaine®, Sanovel, Turkey, 4 ml) was performed on the area from the skin to the intrathecal space. An 18 G spinal needle (Exelint Spinal Needles) was inserted into the lumbosacral space as previously described [6-9] and 20 mg (4 mL total dose) of bupivacaine (Marcaine®, 5 mg/mL AstraZeneca, Turkey) was injected under aseptic condition. In the PG group, 4 mg/kg propofol (Propofol® 1%, 20 ml inj., Fresenious Kabi, Germany) was administered as a single dose i.v. five minutes later, IT anesthesia was performed using 20 mg bupivacaine, similar to that performed in the XG subjects.

All dogs in the XG and PG groups were placed in the lateral position on the operating table at an approximately 30° angle to prevent cranial migration of the local anesthetic. Before surgery, a 22 G polyurethane catheter was aseptically placed into the ramus dorsalis of the saphenous vein and an electrolyte solution (0.9% saline) was administered i.v. at 10 ml/kg/h for the duration of IT anesthesia.

Each dog was monitored with Veterinary Monitor®, MMED-6000DP S6-V (Germany). Systolic blood pressure (SBP), diastolic blood pressure (DBP) mean arterial pressure (MBP), heart rate (HR), respiratory rate (RR), and rectal temperature (RT) were recorded pre-medication (time 0) and at 5, 15, 30, 60, 90 and 120 min after IT injection.

Serum glucose, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and blood urea nitrogen (BUN) values were determined colorimetrically before injection and at 15, 30, 60, and 120 min after IT injection.

The onset, duration, and magnitude of sensory block were assessed by pinpricks using a 23 G needle. A superficial (needle used to prick the skin) and deep (needle inserted up to the muscle layer) pinpricks were performed. Furthermore, painful stimuli were created to assess superficial and deep pain ventral to the caudal abdomen, tail, perineum, and hind limbs. The needle prick was evaluated on a scale of 0 –3 as previously reported [1,9,10]: 0 = no analgesia and normal strong reaction to a stimulus, 1 = mild analgesia and depressed reaction to a stimulus, 2 = moderate analgesia, and no response to superficial needle-prick stimulation of the skin and 3 = complete analgesia and no response to insertion of the needle deep into muscle tissue.

The needle prick procedure was continued until the end of anesthesia even if the operation ended early. Additionally, the depth of anesthesia was checked by compressing the paw and tail end with forceps during anesthesia.

Routine nursing procedures such as suitable postoperative analgesics (Carprofen, 4 mg/kg, intramuscularly, Rimadyl®, Pfizer, Turkey) were provided daily.

Statistical analyses of the data were performed using the Minitab-16 packet program. The Anderson–Darling test was used to determine the normality of data distribution, the Kruskal–Wallis test was used for non-parametric data, and ANOVA (One-way Analysis of Variance-Tukey's pairwise comparisons) with $p < 0.05$ accepted as significant.

Authors' Contributions

SY, EK, CSE, UA, and IO performed the experiments. MO analyzed the data. EC provided research space and equipment. SY and EC wrote the paper.

Conflict of interest

The authors declare that they have no conflicts of interest.

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